

# Hydrogen Certification in Australia, Germany and Japan

Edited by Bertil Wenger & Eva U Wagner

VOLUME 7 / 2021





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# Foreword

Dear Readers,

I am pleased to present to you KAS Australia's latest Periscope Paper edition on "Hydrogen Certification in Australia, Germany and Japan." This edition is published following the second virtual seminar of the 2021 KAS-EUCERS Energy Trialogue. Whilst the first seminar was concerned with the emerging hydrogen economies in, and shared interests by, Australia, Germany and Japan, the second seminar focussed on one of those shared interests.

As outlined in Germany and the European Union's 2020 Hydrogen Strategies, both may need to import hydrogen to meet their domestic demand. On the other hand, Australia's 2019 Hydrogen Strategy provides for the future export of excess hydrogen. Against this backdrop, it is unsurprising that Germany and Australia have commissioned a bilateral hydrogen supply chain feasibility study, and entered into a Hydrogen Accord. Japan published its Basic Hydrogen Strategy in 2017, and is deemed to be a pioneer in the field of hydrogen. For example, the world-first liquefied hydrogen carrier, Suiso Frontier, built by Kawasaki Heavy Industries, is scheduled to arrive in Australia by March 2022, and to transport liquefied hydrogen produced from coal in the Latrobe Valley in the State of Victoria to Japan. The country was therefore chosen as an additional dialogue partner for our annual energy dialogue this year.

As you can take from the contributions, whilst the discussion of hydrogen certification is in full swing in Germany and the EU, the Japanese Government has postponed the official debate of (low-carbon) hydrogen and ammonia pending the availability of technologies and the establishment of supply chains. By way of this edition, KAS Australia seeks to foster the discussion of hydrogen certification required to enable global trade with what has been identified by many countries as part of their economic decarbonisation strategies.

I would like to take this opportunity to thank cordially the experts in the Trialogue, and authors of this publication, for their valuable contributions to the ongoing debate. We look forward to continuing this platform in cooperation with the European Cluster for Climate, Energy and Resource Security next year.

## **Bertil Wenger**

Director - KAS Australia  
Canberra, December 2021

# Hydrogen Certification in Australia

Max Hewitt

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## About the Author

Max Hewitt joined the Smart Energy Council in August 2019 in the role of Division Manager for Hydrogen Australia – a division of the Council. Max has a background in a variety of liberal arts with a strong emphasis on the field of historical inquiry. With well-honed written communication skills and an ability to research quickly and critically, Max fits perfectly with the rapidly changing hydrogen space. In his time in the role Max has organised several online seminars and conferences with leading industry representatives, carried

out multiple market studies of renewable hydrogen projects in Australia, assisted in the development of a world-leading certification scheme, and built a strong industry body with over 100 members.

His other experience includes an internship with CWP Renewables as a Business Analyst, as well as a Research Project for the Queensland Museum. Max has a Bachelor of Arts (Honours) in History, Class II A from the University of Queensland, as well as a Bachelors of Arts – History (Extended Major) and Political Science (Minor).

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**The opportunity for renewable hydrogen is a much talked about topic in Australia – it is not a secret that Australia boasts some of the best wind and solar resources in the world, and further, has the available land to harness these resources on a massive scale. The 26GW Asian Renewable Energy Hub and the 3GW SunCable projects both stand as a testament to the bright ‘green’ future that Australia can unlock given enough ambition.**

It is also no secret that the country has had a long and lucrative history of resource extraction and export – in particular, natural gas and thermal coal. Accordingly, it is anticipated that the early future of hydrogen in Australia will be a mixed production one, that is, a mix of fossil and renewable hydrogen projects for both domestic and international demand markets. Without a nationally mandated energy policy or climate change policy, however, it is ultimately up to the market to decide the near term future of hydrogen in Australia.

Up until recently, the discussion surrounding the certification of hydrogen in Australia was still in the early stages. Currently, the Federal Government Department of Industry, Science, Energy and Resources is developing an approach to deliver a Guarantee of Origin Scheme for hydrogen domestically. This Scheme remains in the concept stage, with the recent publication of a discussion paper in June 2021<sup>1</sup> framing the issues, and consulting industry to gather further data to work in for consideration. The paper proposes an approach to certification of hydrogen from gas-based steam methane reformation (SMR), coal gasification, and electrolysis, focussing on assessing the emissions from the production side. The initial methodology proposed is a ‘cradle

to gate’ methodology, that is, tracking the emissions produced from the point of production, to the point of first sale, before it is transported to the consumer.

It is notable that there is a predominant focus in the Australian Government strategy on the production methods from coal and gas, rather than renewable resources – consequently, there are significant questions raised about the implementation of Carbon Capture, Utilisation and Storage (CCUS) for these processes. Specifically, there are major concerns about the potential to ‘lock-in’ emissions associated with these production processes, in addition to the assumption of constant high capture rates for CCUS processes. These concerns are best outlined in a paper from the Australian National University’s Crawford Institute, which noted that “these ‘low-carbon’ production methods create significant greenhouse gas emissions when realistic capture rates and fugitive emissions from feedstock extraction are taken into account. The extent of the emissions is often downplayed or ignored in governments’ public statements about future hydrogen supply chains, with many treating low-emission and zero-emission production as functionally equivalent or interchangeable. The high rates of carbon

capture typically posited in government strategies are likely to be both difficult to achieve in practice and costly.<sup>12</sup> In particular, pursuing certification of low-carbon products will require careful deliberation and determination of appropriate emissions' thresholds, production technologies, and emissions' capture technologies.

The Australian Government Scheme is also cognisant of the work being carried out by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) in promoting the development of advanced industry standards and protocols to enable international trade on a massive scale. In March 2020, the IPHE announced the Hydrogen Production Analysis Taskforce (H2PA) to develop a mutually agreed methodology for determining the greenhouse gas and other emissions associated with the production of hydrogen.<sup>3</sup> This will be a hugely important achievement for harmonised regulation and standards, but ultimately it is unclear how long it will take for this framework to be developed, adopted and implemented by participating countries within the taskforce.

Conducting a quick scan of the planned, in development, and operational hydrogen projects in Australia will uncover a variety of mobility solutions, gas blending projects, and off-grid and remote energy trials using hydrogen. Further, there are several major export projects planned around the country to satisfy international demand markets – these range in size from the 75MW Eyre Peninsula Demonstrator, to the gargantuan 50GW Western Green Energy Hub. It is notable that the majority of these projects are dependent on hydrogen production from electrolysis and in fact, over 40 of the total 70 projects are planned to be paired with new renewable energy developments to enable the production of

renewable hydrogen.<sup>4</sup> The result is that there is a clear and preeminent need for certification of renewable hydrogen in Australia. There is both a developing domestic market, and major targets being set by international governments, and both will demand transparency over the emissions profile of the hydrogen they use.

As more of Australia's partner countries adopt net zero targets and legislate against new coal developments, further questions are posed regarding the approach of the Federal Government. The progression of the Carbon Border Adjustment Mechanism (CBAM) from the European Union, and other similar carbon pricing mechanisms, have stimulated a great deal of urgency among experienced and emerging export businesses here in Australia, which has consequently progressed the discussion around certification of hydrogen and derivative products. Additionally, the uptake of the Renewable Energy Directive (REDII) legislation has set a clear standard for the requirements for power fuels to be considered against emissions reductions targets. Further, the preference for renewable hydrogen is clear in the German Hydrogen Strategy, noting an aim to support international projects producing renewable hydrogen to accelerate the uptake and trade of hydrogen as a decarbonisation solution. It is the view of Hydrogen Australia that alignment with the goals and objectives of the EU, and in particular Germany, is important to establish appropriate standards and thresholds for emissions intensity – developing a bilateral arrangement with prospective import countries for Australian hydrogen will accelerate the uptake of the product, and the development of an internationally relevant certification scheme for renewable hydrogen.

In December 2020, Hydrogen Australia launched its Zero Carbon Certification Scheme. It is an industry-led Guarantee of Origin style scheme which promotes the uptake and distribution of renewable hydrogen products and their derivatives in Australia and overseas. The Scheme is being managed and delivered through the Smart Energy Council's Hydrogen Australia Division, and will assess the embedded carbon in hydrogen, ammonia and metals produced within participating facilities in Australia and internationally. The Zero Carbon Certification Scheme emphasises a practical, project-based approach – delivering much needed verification and transparency to eligible projects right now, to build trust in the industry, and establish the rules, frameworks and institutions necessary to drive certification of renewable hydrogen and derivative products in the long term.

The requirements for the Scheme are that the energy sourced for the production of hydrogen comes from 100% renewable sources, with a threshold capacity for Power Purchase Agreement (PPA) and other similar arrangements. Initially, the boundary considered for early projects is consistent with a 'cradle-to-gate' boundary. As the Scheme matures it is expected that producers will find a way to deal with the scope 3 emissions produced by transporting the hydrogen or ammonia to the point of sale overseas. This could be done by ensuring that the product is transported using a low emissions fuel, or by purchasing eligible offsets or credits. Over time, an upstream emissions assessment is likely to be a necessary expansion of the Scheme's boundary – consistent with the approach of international governments.

The first pilot project for the Zero Carbon Certification Scheme began in March 2021,

seeking to assess the emissions intensity of hydrogen produced at the ActewAGL hydrogen refuelling station in Canberra, the first refuelling station of its kind in Australia. The project presented a novel opportunity as the Government of the Australian Capital Territory (ACT) – the executive body in the Territory – procures 100% of its energy from renewable sources via a PPA arrangement with the retailers in the area.<sup>5</sup> As a result it was found to be a relatively straightforward process to determine the emissions profile of hydrogen produced at the facility once other factors were considered, for example, the emissions produced from energy used to get the feedstock water to the facility.

Hydrogen Australia commissioned an independent auditor, Point Advisory, to conduct a verification and validation audit to determine the emissions profile of hydrogen produced at the hydrogen refuelling station. The ISO Standard used for this evaluation was ISO17029, "providing confirmation that claims are either plausible with regards to the intended future use or truthfully stated."<sup>6</sup> Ultimately, the auditor verified that the facility was able to produce renewable hydrogen, and provided certainty on a production capacity limit for the next year of operation, determining that the facility could produce up to 7884kg over a year of operation and that the emissions intensity of the produced hydrogen was around 0.01kgCO<sub>2</sub>-e per kgH<sub>2</sub>. The initial assessment is similar to a Proof of Sustainability assessment, and will inform the development of Guarantee of Origin certification. The hydrogen refuelling station in Fyshwick, ACT, was the first hydrogen project certified in Australia, and was fully evaluated under the Zero Carbon Certification Scheme.

The second pilot project, commenced in October 2021, will provide a pre-certification assessment of the Yara Pilbara renewable ammonia production facility. This pre-certification will give an assurance to Yara, its suppliers and customers that it is capable of producing a specified volume of renewable ammonia provided it is built and operated according to specifications. The certification audit will provide an assessment of any and all direct and indirect greenhouse gas emissions associated with the production and storage of the renewable hydrogen at the facility. This will include an assessment and confirmation that 100% renewable electricity is being used to make the renewable hydrogen at the facility. Further, this will include an assessment of any and all greenhouse gas emissions associated with the input and output flows regarding the production of renewable ammonia at the proposed Yara facility, excluding the emissions related to the construction of the facility. The final assessment will be provided using the metric of tonneCO<sub>2</sub>-e per tonneNH<sub>3</sub>, measuring production over a defined period of time and within the established boundary for the project.

An important aspect of the second project will be the assessment of the upstream emissions produced by the transport of renewable ammonia to the point of sale. This is a key requirement to meeting the more stringent international requirements set forth under REDII, and consequently is an important advancement for the Zero Carbon Certification Scheme in working towards the development of international trade for certified renewable hydrogen products. The expansion of the boundary to consider wider transport and upstream scope 3 emissions is still being deliberated in detail, but as mentioned earlier, it is expected that these types of emissions

assessments will become a requirement for consideration as the Scheme matures.

A broader aim of the Zero Carbon Certification Scheme is to align with the sustainable development goals (SDGs) put forward by the United Nations (UN). In Australia, Hydrogen Australia is in the early stages of exploring a working relationship with the Infrastructure Sustainability Council of Australia (ISCA) – a member-based, purpose-led peak body working in Australia and New Zealand to deliver sustainability certification to infrastructure projects at different stages of development. Broader sustainability assessments will be important to consider for hydrogen certification more generally, and can help inform the development of a ‘gold standard’ project which meets rigorous sustainability standards and delivers on objectives like supporting local jobs, and ongoing contribution to community development.

It is the view of Hydrogen Australia that the primary focus should be to verify the production capability of those facilities that claim renewable credentials. Development of a certification scheme focussing on renewable hydrogen and its derivatives will also drive the uptake of renewable production methods, consequently driving down the cost of production. Further, by providing a transparent assessment of the emissions intensity of products, it will allow consumers to make more informed decisions about the types of products they use, and allow them to account for real emissions reductions.

Finally, it can be said that the Zero Carbon Certification Scheme being led by Hydrogen Australia is the most advanced hydrogen certification scheme in the country. There is a clear desire from industry for the implementation of a domestic and an international scheme to assess embedded emissions in hydrogen products. It will be

important to develop an internationally recognised standard and general approach to certification, however there is a preeminent need for an operational certification scheme for hydrogen and hydrogen derivative products now, to allow certified products to be traded and accounted for appropriately. The Zero Carbon Certification Scheme aims to pave the way for further development, and to provide a solution to allow companies and governments to account for emissions in the short term.

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# Certification of Renewable Hydrogen in Germany and the European Union as an Import Requirement

Katharina Sailer and Toni Reinholz

**Katharina Sailer** has been employed as an Expert for Renewable Gases and Bioenergy with the German Energy Agency since 2020. She focusses on hydrogen certification, bio-LNG markets and calculating CO2 certificate prices until 2030. Prior to joining the Agency, Katharina worked for two years at the Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB) where she was mainly involved in the EU ADVANCEFUEL project, which has the aim to facilitate the market roll-out of second generation biofuels. She studied Environment and Resource Management with a specialisation in Energy Studies at the Vrije University of Amsterdam. Katharina's interests are in renewable energies and decarbonising strategies.

**Toni Reinholz** works as Team Leader Bioenergy and Renewable Gases at the German Energy Agency GmbH (dena). He has been working in the field of renewable energies and efficient mobility at the dena since 2012. Toni Reinholz's work focuses on

the analysis of national and international market developments in bioenergy and renewable gases in the electricity, heat and fuel sector. Another focus is on regulatory and implementation-relevant topics regarding the verification of renewable energy sources for target compliance or consumer disclosure. In addition, he coordinates several steering groups within the dena Biogas Partnership, in which around 30 actors along the entire value chain are bundled and supported in their activities to develop the market for the production and use of renewable gases. He is responsible for the technical and conceptual development as well as the further development of the dena Biogasregister, which today represents the largest European electronic Guarantee of Origin system for renewable gases. Prior to this, Toni Reinholz was employed by the German Association of Energy and Water Industries (BDEW) in the sales and gas-specific issues department (2011-2012). Toni Reinholz graduated in economics from the Freie University of Berlin in 2010.

## Why is Hydrogen Certification Needed?

Renewable hydrogen in the Member States of the European Union can be counted towards their national transport targets. But, how can it be proven and verified that the energy carrier was actually produced in a sustainable way? The answer is by way of hydrogen certification.

In the regulatory framework of state aid provision in form of subsidies, tax/levy exemptions, crediting of carbon reductions, etc, certification constitutes an essential tool for demonstrating compliance with the regulations. This framework sets the rules on how “renewable hydrogen” is defined and the requirements it needs to fulfil to be recognised as renewable. In this sense, certification systems mirror the legislative framework.

Hereby, the governance structure of certification in the European Union looks as follows (Figure 1):

1. The European Commission officially recognises the so-called Voluntary Schemes, which translate the regulatory framework into tangible criteria that hydrogen producers must fulfil.
2. Certification Bodies are then recognised by the respective Voluntary Scheme in order to carry out the required audits.
3. Market participants register their renewable hydrogen volumes in a national registry for Proofs of Sustainability (PoS). For example, in Germany, entries are made into the national PoS registry, Nabisys<sup>1</sup>, while in Austria they are entered into EINA<sup>2</sup>.
4. The data from the national registry is then transferred to the EU’s Union Database (UDB). If the respective country has no national registry in place, then the producer can register the renewable hydrogen volumes directly in the UDB.

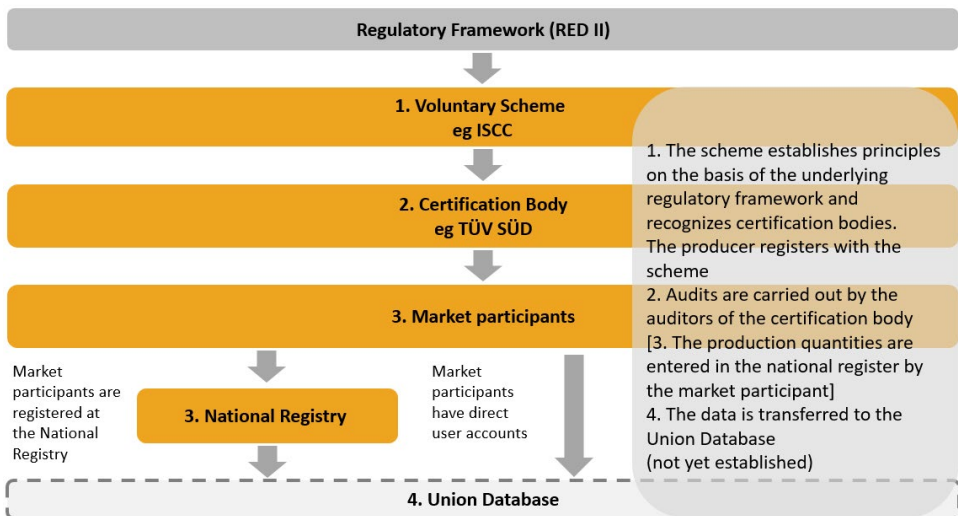


Figure 1: PoS certification process and competent bodies (modified from REGATRACE D4.1. (2021))

## Regulatory Framework

### European Union

The Renewable Energy Directive II (RED II) is currently under revision and an amendment to it will come into force in 2022. The legislation will expand its sectoral scope from the transport sector towards industry, heating and cooling. Furthermore, according to the Fit-for-55 Package, renewable fuels of non-biological origin (RFNBOs) will need to comprise 2.6% of fuels in the transport sector by 2030. In industry, 50% of the consumed hydrogen will have to be renewable hydrogen by 2030.

### The transport sector

The renewable transport sector in the European Union is regulated by RED II, which classifies hydrogen as an RFNBO. So far, Article 27 RED II sets the renewable electricity criteria for RFNBOs. Two delegated Acts<sup>3</sup> under the Directive are expected to be adopted by the end of 2021 and would further refine the sustainability requirements for the energy carrier.

**Renewable electricity criteria [delegated Act on Article 27 RED II]:** This delegated Act aims to further refine the renewable electricity criteria for RFNBOs. Those criteria cover the following aspects:

- **Renewability:** degree of renewable energy input required
- **Additionality:** the additionality criterion is set by the European Commission for prioritising the use of renewable electricity volumes first and foremost for direct applications, while only utilising additionally installed capacities for RFNBO production. RED II defines additionality by the absence of received subsidies.
- **Geographical correlation:** set geographical scope in which the electricity

installation and the electrolyser must be located.

- **Temporal correlation:** time difference between electricity and RFNBO production.

Although the European Commission has not yet published any official details, unofficial information was already leaked on the detailed sustainability criteria for RFNBOs (see Table 1).

**Greenhouse gas emission calculation methodology of RFNBOs [delegated Act on Article 28 RED II]:** This delegated Act provides the methodology to calculate the greenhouse gas emission reduction for RFNBOs. Furthermore, it defines the eligible carbon sources for the methanation of hydrogen. Three different carbon sources exist: biogenic carbon, carbon from Direct Air Capture (DAC) and carbon from industrial point sources (Global Alliance Powerfuels, 2020).

### Germany

The sustainability criteria of the European Union will be transpositioned<sup>4</sup> into the national law by the **37th Federal Emission Control Ordinance** (37. Verordnung zur Durchführung des Bundesimmissionschutzgesetzes) (BImSchVO), which currently sets the rules for being accounted towards the national transport quota.

**The Renewable Energy Act-Ordinance** (Verordnung zur Umsetzung des Erneuerbare-Energien-Gesetzes) (EEG-VO) regulates the renewable electricity market. In Germany, additional costs associated with the renewable characteristics of electricity have to be paid by the consumer via an EEG levy. The German Government aims to exempt hydrogen from the EEG levy on the condition that certain sustainability criteria are met. These sustainability criteria are based - with minor deviations - on the delegated Act on Article 27 RED II (see Table 1).



Table 1. Renewable electricity criteria for RFNBO production and its implementation in the national legislation for exemption of hydrogen volumes from the EEG levy.

Legislation	Delegated Act on Article 27 RED II as per leaked information	German Renewable Energy Act-Ordinance (EEG-VO)
<b>Geographical scope</b>	European Union	Germany
<b>Purpose</b>	Crediting towards the renewable transport targets	Exemption from EEG levy to reduce hydrogen production costs
	<b>Renewable electricity criteria for power fuels</b>	
<b>Renewability</b>	<p>The consumed electricity must be 100% renewable and proven by a Power Purchase Agreement (PPA).</p> <p>Direct connection + indirect connection (grid):</p> <p>Proof with smart meter that the hydrogen was solely produced through direct connection</p>	<p>The consumed electricity must be 100% renewable. If the electricity installation is indirectly connected to the electrolyser via the electricity grid, further proof is required in form of cancelled Guarantees of Origin (GOs). The GOs must be coupled with the electricity supply when produced and consumed in Germany.</p>
<p><b>Additionality</b></p> <p>+</p> <p><b>System serviceability</b></p>	<p>The renewable electricity must not be subsidised and must be produced by an installation that has a new installation or has undergone major refurbishment<sup>5</sup></p> <p><u>Direct connection:</u></p> <p>New plants must be commissioned within a maximum of 12 months prior to the electrolyser.</p> <p><u>Indirect connection (grid):</u></p> <p>Option 1: electricity installation was implemented OR undergone major refurbishment max. 24 months prior to the electrolyser + unsubsidised, or</p> <p>Option 2: one hour correlation + proof that power-generating facilities were downward redispatched + both installations are located on the same side of the congestion causing the redispatch, or</p> <p>Option 3: one hour correlation + price of electricity in the bidding zone is lower or equal to 0€ per MWh.</p>	<p>The electricity installation must not be subsidised.</p> <p>Hydrogen is only exempt from the EEG levy if it is produced during the first 5,000 full load hours of an installation.</p>

Table 1. Continued

Legislation	Delegated Act on Article 27 RED II as per leaked information	German Renewable Energy Act-Ordinance (EEG-VO)
<b>Geographical Correlation</b>	The criteria for the geographical correlation between the electricity plants and the electrolyser is set at the same bidding zone <sup>6</sup> or two different bidding zones, if they have the same electricity price on the day-ahead market + same calendar hour	85% of the consumed electricity must be produced in Germany and a maximum of 15% of the consumed electricity may be produced in a neighbouring country physically connected to Germany through the power grid.
<b>Temporal Correlation</b>	<p>Option 1: same calendar hour + PPA, or</p> <p>Option 2: same calendar hour + higher RE-share in the respective bidding zone compared to the bidding zone three years prior, or</p> <p>Option 3: same calendar hour + power-generating facilities using renewable energy sources were downward redispatched + located on the same side of the congestion causing the redispatch, or;</p> <p>Option 4: from a storage asset located behind the same grid connection point as the electrolyser that has been charged in during a calendar hour fulfilling the criteria in option 1, 2, or 3</p>	The maximum time difference between the electricity and the RFNBO production (for a direct connection) is set at 15 minutes.

## Voluntary Schemes

Under Renewable Energy Directive (RED I), there were 16 Voluntary Schemes recognised for biofuel certification. Under RED II, no Voluntary Schemes have been officially recognised yet. However, 13 Schemes were already positively assessed. Voluntary Schemes aiming to certify hydrogen will still have to wait for the adoption of delegated legislation (two acts) before they can submit proposals for the verification process of their requirements.

ISCC and CertifHy already voiced their intention to seek recognition as a Voluntary Scheme for RFNBOs.

There are already voluntary hydrogen standards available on the market such as ISCC Plus and the TÜV Süd CMS 70 standard. They do, however, not mirror the legislative framework, so that their certified volumes cannot be counted towards national targets or guarantee any state aid provision. Their certificates mainly serve marketing purposes.

## Union Database

RED II provides for the implementation of a Union Database (UDB). Its aim would be to prevent double counting of PoS when traded across the national borders of Member States. The UDB would be connected to the national registries of the Member States, if any, as well as to Voluntary Schemes. If a Member State has no national registry for PoS in place, the UDB would offer direct user accounts for fuel producers (Guidehouse, 2020)<sup>7</sup>.

The implementation of the UDB is scheduled to be completed by the end of 2022 and is planned in two phases:

- First Phase 1: Low risk value chains [starting from the collection point/ trader]
- Second Phase 1: High risk value chains [starting from the point of origin]

The tracking model is aimed to be segregation/mass balancing. A harmonised material list in form of a drop-down menu will be based on the EUROSTAT Database. A PoS-ID is created and can be tracked in the system. Furthermore, a QR code will be generated for showing information on the material origins, but no confidential information. Currently, it is also discussed if national schemes (third party databases) should be mirrored in the UDB, even if they are not officially recognised by the European Commission.

## Global Harmonisation of Hydrogen Certification

An all-encompassing global certification system for hydrogen would lead to more flexibility of hydrogen volumes towards fluctuating prices in regards to international trade and consequently create higher market efficiencies and a faster market ramp-up. Currently, there are various hydrogen standards globally.

Among its latest work, the German Energy Agency (dena) assessed whether a uniform global certification system for renewable hydrogen is feasible. For this purpose, ten hydrogen regulations/standards (ISCC PLUS, CertifHy, dena Biogasregister, TÜV Süd CMS 70, China Hydrogen Alliance's Standard, the Certification Scheme of the Japanese Prefecture Aichi, the funding programme H2 Global, the Californian Low Carbon Fuel Standard, EU Renewable Energy Directive II and the UK Renewable Transport Fuel Obligation) were assessed for their harmonisation potential.

In **Australia**, The Smart Energy Council launched their Zero Carbon Certification Scheme for hydrogen and ammonia in December 2020 (Smart Energy Council, 2020). They are currently conducting pilot testing of their scheme.

In **Japan**, the Prefecture Aichi set up its own hydrogen certification scheme. The scheme sets renewable electricity as a production input requirement, and mass balancing as the tracking model for the chain of custody. The system boundary of the GHG methodology in the scheme is Well-to-Gate (Adelphi, 2019; dena & WEC, 2022).

The most harmonised sustainability requirements of all ten hydrogen standards/regulations evaluated are the use of *renewable electricity inputs, mass balancing* as the tracking model, as well as the eligibility of *all carbon sources* provided that they are not deliberately produced for the power fuel production.

The assessment concludes that a global certification system will not be feasible, as it is unlikely that certain markets (eg the EU) would give up their long-established ambitious criteria (eg the renewable electricity criteria according to Article 27 RED II in the European Union) for the sake of a globally harmonised system.

However, dena and the World Energy Council (2022) propose a system concept that is recognised for the transport sector by all ten hydrogen regulations/standards assessed:

- Direct line to a renewable source of electricity
- 70% GHG reduction compared to the reference value of 94 gCO<sub>2</sub>e<sub>qu</sub>/MJ
- Carbon from Direct-Air-Capture (DAC) as an allowable carbon source for power fuels

Furthermore, the chain of custody must be tracked by mass balancing.

## Conclusion

Certification schemes mirror the legislative framework. In the EU, the ratification of the final legislation regarding the sustainability criteria for renewable hydrogen is still pending. Once this is finalised, certification schemes can apply to be officially recognised as a Voluntary Scheme by the European Commission and carry out hydrogen certification for the transport sector and industry. Currently, voluntary market-based renewable hydrogen standards (ISCC Plus, TÜV Süd) already exist, but their certificates cannot be used to take advantage of governmental support or get the hydrogen volumes counted towards national renewable energy targets. They mainly serve marketing purposes.

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- 1 <https://nabisy.ble.de/app/locale%3Bjsession-id=428BEBC86FD4DB9840B749357EE583FB?set=en>
- 2 <https://www.umweltbundesamt.at/en/>
- 3 What is a delegated Act? Please check the following link for further information. Implementing and delegated acts | European Commission ([https://ec.europa.eu/info/law/law-making-process/adopting-eu-law/implementing-and-delegated-acts\\_en](https://ec.europa.eu/info/law/law-making-process/adopting-eu-law/implementing-and-delegated-acts_en))
- 4 What is national transposition? National transposition is the implementation of EU law into national law of the EU Member States. EU law sets the minimum standards that member states must adopt, they can implement stricter rules.
- 5 20% of consumed electricity is exempt from this rule, when the producer make a financial contribution to the Union renewable energy financing mechanism equal to the consumed 20%
- 6 A bidding zone is defined as the largest geographical area in which market participants are able to exchange energy without capacity allocation. Bidding zones differ in the European Union. For instance, in Germany the bidding zone equals the national territory whereas Italy has several bidding zones. (ofgem, 2014)
- 7 <https://op.europa.eu/en/publication-detail/-/publication/f9325197-f991-11ea-b44f-01aa75ed71a1/language-en/format-PDF/source-157051253>

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# The Certification of Low-Carbon Ammonia and Hydrogen in Japan

Dr Seichiro Kimura

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Dr Seichiro KIMURA (Ph.D., P.E.jp) joined the Renewable Energy Institute in 2018. He specialises in cost-benefit analysis, techno-economic analysis with market penetrating simulation in the energy system. Seichiro started his career at Mitsubishi Heavy Industries in 2004, and was engaged in the development of hydrogen energy until 2010. After working for the International Institute for Carbon-Neutral Energy Research of Kyushu University, he became an Associate at the Matsushita Institute of Government

and Management between 2014 and 2018, where he was engaged in research on interconnecting electric power systems with the aim of increasing energy self-sufficiency through its own resources and eventually becoming a nation capable of supplying energy to other countries (energy-exporting nation). Seichiro received a B.Sc. from Tokyo University of Science, M.Sc. from Tokyo Institute of Technology, and a Ph.D. from Kyushu University.

This analysis brief describes the discussion on the certification of low-carbon ammonia and hydrogen, including green ammonia and green hydrogen, in Japan. On 26 October 2020, the Japanese Government declared the country's objective to be carbon neutral by 2050. Since then, the discussion of decarbonisation has taken up pace. However, there has been no deepening of the discussion on the certification and use of low-carbon hydrogen and ammonia. One of the reasons is the use of ammonia as a replacement for coal. The term "hydrogen and ammonia" utilisation, rather than "hydrogen" utilisation, has come to be used in the documents of the "6th Strategic Energy Plan". Furthermore, since coal-ammonia co-firing technology is still in development, it is now accepted that discussions on low-carbon hydrogen and ammonia will be held after the technology is available and the supply chain is established. In the future, the Japanese Government is expected to discuss the certification of low-carbon hydrogen and ammonia, but there is no fixed date for the certification to become operational.

On 26 October 2020, the Suga administration declared that Japan would achieve carbon neutrality by 2050. Prior to 2020, the Japanese Government's target for 2050 was 80% reduction (base year not prescribed). As the global trend toward decarbonisation intensified, discussions on the phase out of "inefficient coal power plants" began in August 2020 with a Working Group (WG) in the Ministry of Economy, Trade and Industry (METI) (Working Group on Coal-Fired Power).<sup>1</sup> The WG *inter alia* discussed the use of ammonia as an alternative to coal. On 27 October, on the day after the declaration of carbon neutrality, the Public-Private Council for the Introduction of Fuel Ammonia<sup>2</sup>, consisting of thermal

power producers, trading companies, machinery manufacturers, and others, was established in METI.

According to a final report by the Fuel Ammonia Council, Japan currently consumes 1 million tons of ammonia annually, 20% of which are imported mainly from Indonesia and Malaysia. It is assumed that this would increase to 3 million tons per year by 2030 and 30 million tons per year by 2050. While the current global trade volume of ammonia is estimated to be 20 million tons, the supply side will focus on the establishment of a supply chain that can handle more than 1.5 times the current trade volume in Japan alone. This includes the introduction of a capable technology. On the demand side, emphasis was placed on the establishment of technologies for co-firing coal and ammonia in boilers and for exclusively firing ammonia. As for low-carbon ammonia, the report stated as follows:

"Toward carbon neutrality in 2050, we will aim to realise dedicated ammonia-fired power generation, with a step-by-step transition being realistic. The first step is to realise the co-firing of ammonia in thermal power generation, but for the time being, the introduction and market creation of fuel ammonia should be pursued without treatment of CO<sub>2</sub> in the manufacturing process, having due regard to the relationship with the manufacturing country (legal system of the manufacturing country, etc). Then, after achieving a certain market size, CO<sub>2</sub> emitted during production should be treated in a rational manner through appropriate means ranging from CO<sub>2</sub> enhanced oil recovery (EOR), carbon capture and storage (CCS), carbon recycling, afforestation and offsetting with voluntary credits. In addition, through producing non-fossil values, we will foster an environment

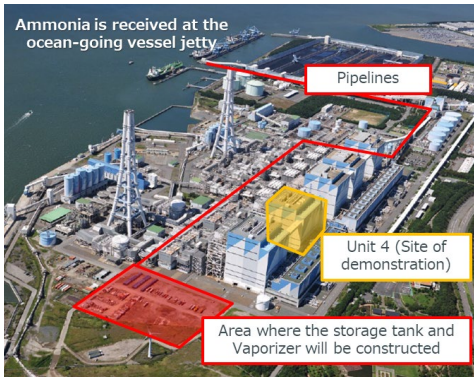


Fig 1 JERA's Demonstration Project at Hekinan coal-fired power plant<sup>3</sup>

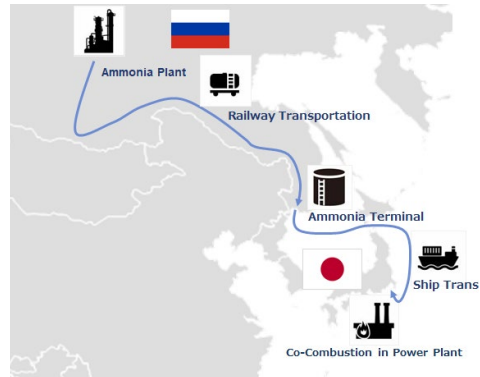


Fig 2 Flow Diagram (Schematic) of the Ammonia Value Chain between Eastern Siberia and Japan<sup>4</sup>

in which ammonia-derived electricity is valued and the investment predictability of business operators is ensured.”

Further, the final report of the above-mentioned WG stated the following about low-carbon hydrogen and low-carbon ammonia:

“For the time being, whether ammonia and hydrogen are carbon-free or not (derived from non-fossil energy or fossil fuel) will not be questioned from the viewpoint of technological development and supply chain building, but their future treatment will be examined based on the actual situation.”

In other words, the METI Working Group in charge of policies related to hydrogen and ammonia placed the highest priority on establishing utilisation technologies, including the construction of supply chains, while using cost-competitive gray ammonia, and aiming to promote the use of ammonia as a fuel internationally. Thus, the certification of low-carbon hydrogen and ammonia was positioned as a future issue.

This was also reflected in the Japan’s 6th Strategic Energy Plan, which was adopted on 21 October 2021. While the 5th Strategic Energy Plan focussed only on “hydrogen”, the new 6th Strategic Energy Plan refers to “hydrogen and ammonia”. Furthermore, the new Plan sets a quantitative target for 1% of all electricity to be generated by hydrogen and ammonia by 2030.

With these government initiatives, Japanese thermal power producers and trading companies are working to build ammonia and hydrogen supply chains overseas. JERA, the biggest thermal power company in Japan, aims to achieve 20% ammonia co-firing at a domestic coal fired power plant by 2024 (Fig1)<sup>3</sup>, and has signed agreements with Petronas of Malaysia and Yara International of Norway to collaborate on building ammonia supply chains. JERA’s project is supported by the 2 trillion JPY “Green Innovation Fund” created on the occasion of the Japanese Government’s carbon neutral declaration. J-power, the second biggest thermal power company, is working with Iwatani Corporation, Kawasaki Heavy Industries



and others on a demonstration project to transport hydrogen produced from lignite coal in Victoria, Australia, as liquefied hydrogen for use in thermal power generation. This project is also financed by the Green Innovation Fund and the goal is set at 30 JPY/Nm<sup>3</sup>-H<sub>2</sub> by 2030. The budget for this project is approximately 300 billion JPY until 2030.

ITOCHU Corporation is considering to transport natural gas-derived hydrogen or ammonia from East Siberia to Japan, and is also conducting a feasibility study on the use of EOR to increase oil production (Fig 2)<sup>4</sup>. Marubeni Corporation, in collaboration with Woodside Energy of Australia and other companies, is carrying out a study on the establishment of a supply chain for green ammonia produced by hydro-power in Tasmania and natural gas-derived ammonia (Fig 3).<sup>5</sup>

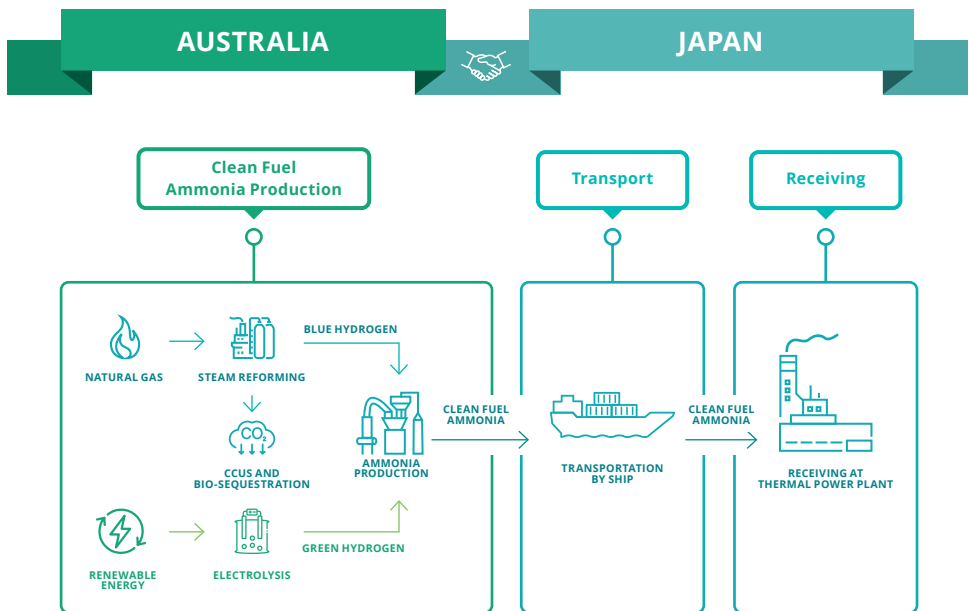


Fig 3 The clean fuel ammonia supply chain between Australia and Japan<sup>5</sup>

Regarding the gas-derived ammonia project, JERA and IHI also joined the project and plan to transport the ammonia for the above mentioned coal fired power plant. The consortium that consists of Iwatani, Kawasaki Heavy Industries, Marubeni Corporation, Stanwell in Australia, etc, has announced a detailed feasibility study on the development of a large-scale renewable hydrogen project in Central Queensland from 2021 (Fig 4).<sup>6</sup>

Mitsubishi Corporation, in collaboration with Royal Dutch Shell, is studying the establishment of a supply chain for natural gas-derived ammonia produced in Canada and supplied as fuel ammonia for thermal power plants in Japan. Mitsubishi Corporation, in collaboration with Saudi Aramco and others, also conducted a demonstration project in 2020 to supply Japan with ammonia produced in Saudi Arabia. Green ammonia produced from renewable energy is expected to be supplied to Japan around 2025.

Mitsui & Co has agreed with Wesfarmers Chemicals, Energy & Fertilisers Limited of Australia to conduct a study on the establishment of a project to supply Japan with ammonia produced by reforming natural gas with carbon capture and storage (CCS) in Western Australia (Fig 5).<sup>7</sup>

Both Mitsubishi Corporation and Mitsui & Co have entered into an agreement with Denbury Inc in Texas on carbon capture, use and storage (CCUS) operations for fuel ammonia or carbon-negative oil production in the US Gulf of Mexico. Thus, we can see that in Japan, both governmental discussions and corporate activities are primarily focussed on efforts to establish a supply chain that uses ammonia as a fuel in thermal power generation.

On the other hand, as far as hydrogen certification is concerned, so far, the Council

for a Strategy for Hydrogen and Fuel Cells (CSHFC) has played an important role. The CSHFC was established in METI in 2013, with members including gas companies, electric power companies, automobile companies, university professors, machinery and chemical manufacturers, journalists, and local government governors, and has been discussing the widespread use of fuel cell vehicles (FCVs) and fuel cell combined heat and power (CHP) systems. Discussions on the certification of low carbon hydrogen was started in a sub-WG of the CSHFC, and then the need for a certification scheme for low-carbon hydrogen was highlighted in a report published in 2017. In early 2018, four categories (1star: 1.0-3.5 kg-CO<sub>2</sub>/Nm<sup>3</sup>-H<sub>2</sub>, 2star: 0.7-1.0 kg-CO<sub>2</sub>/Nm<sup>3</sup>-H<sub>2</sub>, 3star: 0.4-0.7 kg-CO<sub>2</sub>/Nm<sup>3</sup>-H<sub>2</sub>, 4star:0.1-0.4 kg-CO<sub>2</sub>/Nm<sup>3</sup>-H<sub>2</sub>) were proposed in the CO<sub>2</sub> Free Hydrogen WG. However, no concrete discussion has taken place since then. One reason for this is that the distribution of FCVs has not progressed as much as expected, and the volume of hydrogen distribution has not expanded. In addition, as mentioned above, hydrogen and ammonia were both identified as thermal power generation fuels to be imported from overseas in the new 6<sup>th</sup> Strategic Energy Plan adopted in 2021. For as long as the discussion on low-carbon ammonia does not progress, it remains difficult to discuss low-carbon hydrogen.

As a regional initiative on certification, Aichi Prefecture (the Prefecture where Toyota Motor Corporation's headquarters is located) launched a certification scheme for low-carbon hydrogen production in April 2018. Specifically, when renewable electricity, biogas, or the sodium hydroxide by-product hydrogen is used, the scheme certifies the hydrogen production project and then measures the actual CO<sub>2</sub> emissions.

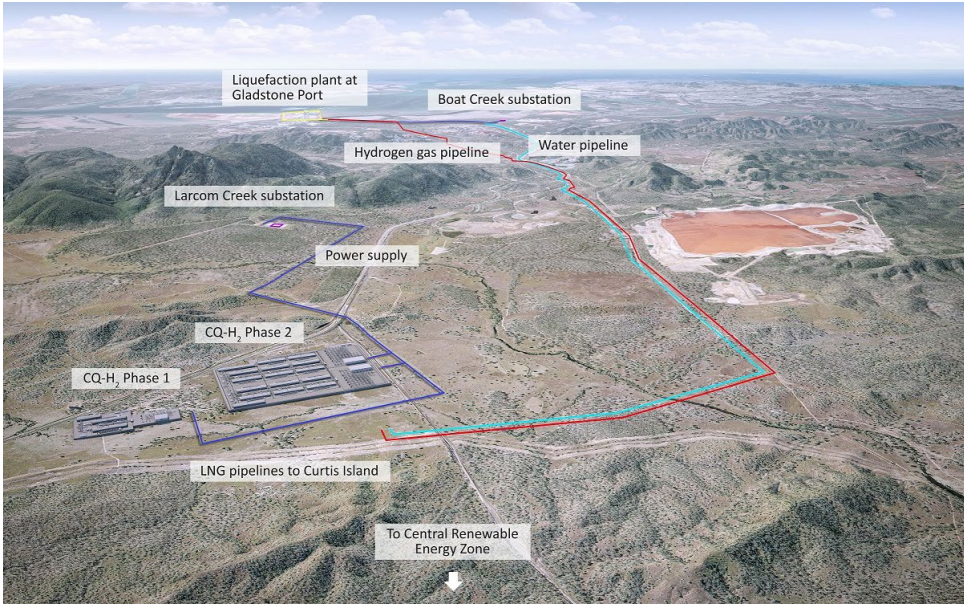


Fig 4 The proposed hydrogen supply chain, from hydrogen electrolysis facility to liquefaction and shipping from the Central Queensland Renewable Hydrogen Project<sup>6</sup>

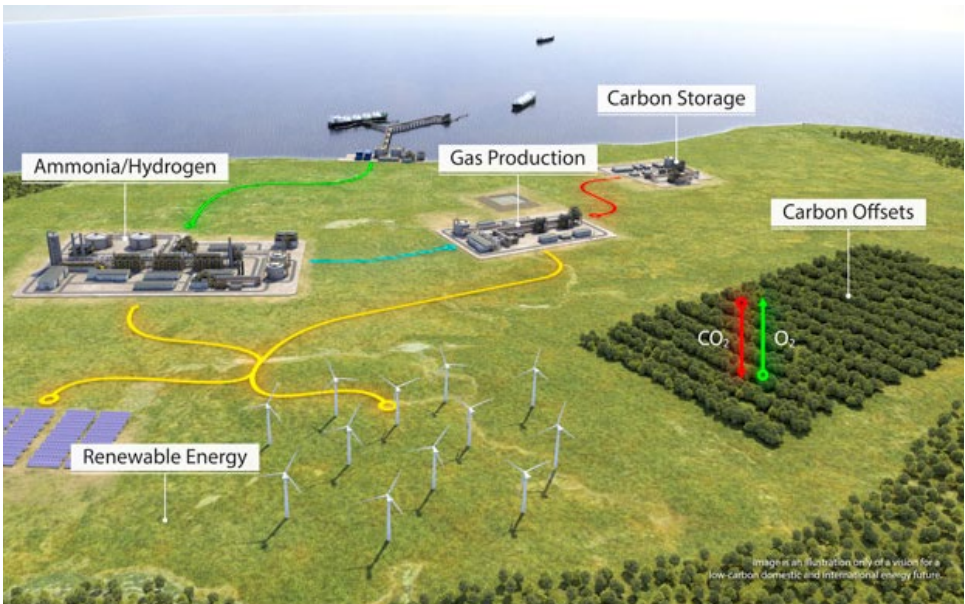


Fig 5 Mitsui & Co vision for a low-carbon domestic and international energy future<sup>7</sup>

## Chita City and Toyota City Renewable Energy-use Low-carbon Hydrogen Project

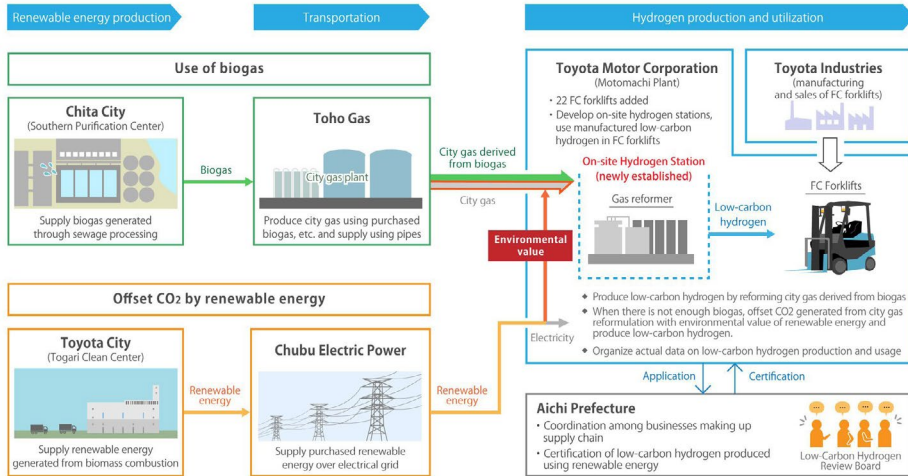


Fig 6 One of the low-carbon hydrogen supply schemes certified by Aichi Prefectural Government<sup>8</sup>

Five projects (four of which are undertaken by Toyota Motor Corporation) have already been certified and are using green hydrogen certified by Aichi Prefecture (Fig 6).<sup>8</sup>

### Summary

Government level discussions on the certification of low-carbon hydrogen took place in 2017 but with little progress made in expanding hydrogen demand for FCVs, those discussions have not progressed since 2018. One local government initiative is in operation for low-carbon hydrogen certification. In addition, since the declaration of carbon neutrality in 2020, the Japanese Government and companies have begun to actively consider the use of fuel ammonia in thermal power generation, so the focus is now on technology and supply chain development for the use of both ammonia and hydrogen. In the future, the Japanese Government is expected to discuss the certification of low-carbon hydrogen and ammonia, but there is no fixed date for the certification scheme to become operational.

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# Conclusions

Dr Emma Aisbett

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Dr Emma Aisbett is a Fellow at the School of Regulation and Global Governance and Associate Director (Research) for the Zero-Carbon Energy for the Asia Pacific Grand Challenge at the Australian National University. Emma works across disciplines and sectors on questions at the intersection of international economic regulation and the environment. Her current research focusses on Trade-Related Climate Policies

such as certification, and their intersection with Green Industrial Policy. In addition to publishing in leading journals in economics, political science, law and engineering, Emma provides expertise to Australian Government and industry, and to international organisations such as the OECD and UNCTAD. Emma is currently leading the Australian certification work in the Germany-Australia HySupply project.



## The three proceeding contributions to this Periscope edition highlight the divergence of approaches to certification in the emergent hydrogen economy.

Of the three countries discussed, Germany is the most advanced and ambitious in its approach, with both formal regulation and voluntary schemes both well progressed. In contrast, Japanese Government and industry have made clear that their priority until at least 2030 is to secure reliable supplies of low-cost hydrogen and ammonia, the emissions credentials of these fuels are of secondary importance. These contrasting approaches of two market leaders in the downstream hydrogen economy present challenges for aspiring exporters such as Australia. It is not surprising, therefore, that we are seeing a diversity of public and private approaches to both production and certification of hydrogen vectors in Australia. This conclusion will situate these approaches in light of the political, economic and environmental drivers in each country and suggest ways forward.

### Challenges for Germany

German regulators face a challenge because they are trying to achieve two goals: one environmental, and one industrial. Their environmental goal is to minimise emissions leakage, that is, to ensure reductions achieved by switching to hydrogen and derivatives in Germany are not offset by increases in emissions elsewhere due to their production.<sup>1</sup> The motivation for this goal is understood to be a combination of enlightened self-interest – which recognises that greenhouse gases are global pollutants – and political economy concerns – whereby German hydrogen producers do

not want to be disadvantaged by competing with producers who face less onerous emissions constraints. Wind farms in the North of Germany – the electricity sales of which are constrained by grid bottlenecks – are a case in point.

Meanwhile, the industrial goal for Germany is to help German companies stay at the forefront of development and commercialisation of hydrogen value chains, both downstream (including green steel and fuel cells) and upstream (including electrolyzers). Competitiveness of these industries relies on them being able to capture early dynamic economies of scale. For the downstream industries this relies on them having access to competitively priced hydrogen and derivatives.

German regulation and certification of hydrogen and derivatives illustrates the balancing of environmental and industrial motives. On the environment side, research from the Australian National University (ANU) has shown that hydrogen derived from fossil fuels will struggle to meet even the current voluntary CertifHy standard (Longden et al., 2022). Updated standards to meet the requirements of the Fit for 55 package are likely to be stricter still. Meanwhile, Katharina Sailer's contribution to this Periscope explains that certified hydrogen produced from renewable energy will need to meet the strict new REDII criteria, as well as prove it has not benefited from renewable energy subsidies. On the other hand, she notes that hydrogen production is likely to be exempt from Germany's renewable energy levy. Similarly, hydrogen

has not been included in the EU proposed Carbon-Border Adjustment Mechanism (though ammonia has) (EU Commission, 2021).

In order to meet both environmental and industrial objectives, Germany needs renewable hydrogen to rapidly become cheaper than other forms of hydrogen. To do this, the country needs the green hydrogen industry to grow so it can reap economies of scale. Strict certification requirements and clear signals that fossil hydrogen will not have a market in Germany is the unilateral best approach. But the benefits would be much greater if they could convince markets such as Japan to take a similar approach.

## Risks for Japan

Japanese regulators are also aiming to achieve a combination of environmental and industrial goals. As Seiichiro Kimura explains in his contribution to this Periscope, for Japan, the central environmental goal is its Net Zero by 2050 commitment. Emissions leakage does not seem to be a concern. Since the emissions produced when hydrogen and ammonia are used in Japan do not depend on how they were produced, fossil and renewable versions are equally useful for helping meet Net Zero commitments. For Japan, the emphasis is on cheap hydrogen and ammonia to lower the cost of meeting these commitments and help Japanese downstream industry and technologies gain advantage in global competition. Certification of the emissions credentials of hydrogen vectors is something to worry about in the future, after supply chains have been established.

Although understandable, the current Japanese approach presents several political and economic risks. Firstly, there is the risk

that the Japanese public realises they are paying a high price for their own net zero transition, without actually doing anything to reduce global greenhouse emissions or mitigate climate change. The global emissions from co-firing hydrogen made from brown coal such as that being produced in Victoria are around 50% higher than the emissions from firing the coal it replaces (Longden et al, 2022). At the other end of the supply chains there are also political risks. Voters in producing countries – who will be paying the price for their own net zero transitions – may be frustrated that their efforts are being undermined by increased emissions from production of hydrogen for export to Japan. The social licence underpinning the supply chains that Japan seeks to establish may well be withdrawn. If that is the case, Japan may pay the price for not investing more in stable, long-term supply relationships with clean hydrogen and ammonia producers. From an economic perspective, there is the risk that the global price of credible carbon offsets will rise steeply in the coming decade, leaving Japan having established expensive supply relationships. An additional economic risk is that carbon border adjustments become more commonly applied by Japan's export markets – and that they expand to include Scope 3 emissions. Indeed, Scope 3 emissions are already a concern for multinational companies such as Apple, Google and Microsoft that have committed to net zero supply chains. These firms have a disincentive to invest in Japan's hydrogen economy. Japanese participation in international hydrogen certification could help send valuable signals to investors, as well as help lower costs for Japanese-based firms wishing to decarbonise their supply chains.

## Horses for courses in Australia

In contrast to Japan, certification of hydrogen and ammonia is a big topic in Australia. If anything, there is an embarrassment of riches. The Australian Government is developing its Guarantee of Origin Scheme which it seeks to make compatible for domestic and international markets, and playing a key role in the international scheme being developed by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE).<sup>2</sup> Meanwhile, the renewable energy industry is developing its own Zero-Carbon hydrogen certification scheme through Hydrogen Australia (a division of the Smart Energy Council). At the same time, the Australian chapter of the Ammonia Energy Association is a driving force behind its certification scheme. This apparent multiplication of effort is a reflection not only of the potential Australia sees in hydrogen and ammonia exports, but also the competing forces in domestic and international markets.

Max Hewitt's contribution to this Periscope highlights the fact that two hydrogen industries are growing in competition in Australia. Seeking to exploit Australia's vast renewable energy potential, dozens of "green" hydrogen and ammonia projects from small to mega scale are under development. Meanwhile, seeking to remain relevant and profitable in a decarbonising global economy, Australia's fossil fuel industry is also looking to move into hydrogen and ammonia production.

The Australian Government's response to the competing forms of hydrogen is to take a *de jure* "technology neutral" approach to hydrogen industrial policy, including certification (Aisbett et al., 2021). The focus of Government certification efforts is on certifying the embodied emissions in the

product, rather than the "colour". From the perspective of the renewable hydrogen and ammonia industry, the Government's approach is frustratingly slow, both because it must consult widely with domestic and international stakeholders, and because methods for verifying emissions embedded in fossil hydrogen are more complicated than those required for 100% renewable hydrogen.

## A way forward?

Efficient international trade of hydrogen and its derivatives can lower the cost and increase the benefits of the net zero transition for all three countries. Yet, despite a common understanding of the importance of consistency and interoperability of certification to free trade, political, economic and environmental considerations are driving divergent approaches in all three countries.

Katharina Sailer's contribution refers to the important work undertaken by the German Energy Agency (dena) to assess the potential for a uniform global hydrogen certification scheme, and notes its disappointing conclusion. None-the-less, they propose a minimalist concept that is consistent with the schemes they assessed. Establishing a global norm – even if less ambitious than some parties would like – is a common approach in international governance. Global norms can often establish a ground level on which more ambitious approaches can build.

An alternative approach could be to facilitate upward and downward compatibility through a Mutual Recognition Agreement (MRA). In an MRA, the principle of mutual recognition is "strictly confined to the recognition of technical competence of designated foreign bodies,



in the exporting country, in specific product markets, to perform conformity assessment for products to the rules and procedures of the importing country.” (Correia de Brito et al., 2016, p.10). In the context of hydrogen certification, it would mean that bodies such as Hydrogen Australia would be recognised as able to certify hydrogen in accordance with EU regulations, and similarly bodies like TÜV Süd could be recognised as certifiers for the Australian Government’s Guarantee of Origin Scheme. Suitable Japanese organisations could be recognised as able to certify in accordance with either government’s requirements.

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## Editors

Bertil Wenger & Eva U Wagner

## Publisher

Konrad Adenauer Stiftung (Australia) Limited  
Regional Programme Australia and the Pacific

11/3 Sydney Avenue  
Barton ACT 2600  
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## ISSN

Periscope – Occasional Analysis Paper Series #7 (December 2021).

ISSN 2652-7324 (Print)

ISSN 2652-7332 (Online)

## Design, Layout and Typeset

Swell Design Group

## Paper

ecoStar+ is an environmentally responsible paper. The fibre source is FSC Recycled certified. ecoStar+ is manufactured from 100% post consumer recycled paper in a process chlorine free environment under the ISO 14001 environmental management system.








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